

TITLE OF THE INVENTION

RECORDING MEDIUM FOR STORING ENCRYPTED AUDIO DATA, APPARATUS FOR AND METHOD OF RECORDING THE SAME, AND APPARATUS FOR AND METHOD OF REPRODUCING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Korean Application Nos. 00-15906 and 00-20437 filed March 28, 2000 and April 18, 2000 in the Korean Patent Office, the disclosures of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to the field of recording and/or reproducing audio and video data on a digital recording medium, and more particularly, to a recording medium for storing audio data encrypted to prevent illegal copying, an apparatus for and a method of recording the same, and an apparatus for and a method of reproducing the same.

2. Description of the Related Art

[0003] An example of a digital recording medium for recording digital video and/or audio information is a digital versatile disc (DVD). Specifications for recording audio information on a DVD include, for example, a DVD specification for Read-Only Disc, Part 3, Video Specifications, Version 1.0, August 1995 (the DVD-Video Specification), and a DVD Specification for Read-Only Disc, Part 4, Audio Specifications, Version 1.0, March 1999, (the DVD-Audio Specification).

[0004] According to these specifications, high-quality video and audio information can be recorded on a disc. However, due to the characteristics of digital information, making a copy which reproduces sound almost the same as the original sound and picture is possible, and therefore a means to prevent illegal copying is needed.

[0005] A method which is widely used recently as a method for preventing illegal copying is to encrypt the recorded information. In the encryption method, all information

or the most important part to be used in interpreting the information is encrypted so that copies cannot be used where the information is illegally copied.

[0006] However, the DVD-Video recording and/or reproducing apparatus and the DVD-Audio recording and/or reproducing apparatus define respective encryption methods for preventing illegal copying.

[0007] Since the DVD-Audio specification does not include provisions for moving pictures, in case of a music video, for which moving pictures and music are recorded together, moving picture information and music information are first made according to the DVD-Video specifications and recorded in a video region. Then, reproducing information for reproducing moving picture information and reproducing information for reproducing music information are recorded in a DVD-Video region and a DVD-Audio region, respectively, so that a DVD-Audio apparatus can reproduce both moving picture information and music information.

[0008] Meanwhile, since the DVD-Video specification is defined from the viewpoint that moving pictures are main and sound is auxiliary, the encryption method is applied only to video information and not applied to audio information. According to this, the decoding speed of the decoder can be raised, but prevention of illegal copying of audio information is difficult, which is contained in the music video and is very worthy of protection. Also, in case where audio information is encrypted according to a specification other than the existing DVD-Video specification, the audio information cannot be reproduced through the existing DVD-Video reproducing apparatus.

[0009] FIG. 1 illustrates the data structure on a DVD-ROM disc complying with the existing DVD-Video and DVD-Audio specifications, and explains the existing method for encrypting video information and audio information.

[0010] On the DVD-Video region on the DVD-ROM disc, video information 21, which can be protected from illegal copying through encryption, and audio information 22, which is not encrypted, are recorded. Also, reproducing management information (not shown) for reproducing the information is recorded.

[0011] On the DVD-Audio region of the DVD-ROM disc, audio information 23, which can be protected from illegal copying through an encryption method different from that of the video information, is recorded. Also in the DVD-Audio region, reproducing management

information (not shown) for reproducing audio information 23, reproducing management information (not shown) for reproducing video information 21 and audio information 22 recorded in the DVD-Video region, and/or reproducing management information (not shown) for reproducing only audio information 22 recorded in the DVD-Video region are recorded.

[0012] Meanwhile, the DVD-Video specification defines provisions for encrypting only video information and does not provide an encryption method for encrypting audio information. That is, according to the DVD-Video specification, in case of music video in which audio information is main and moving picture information is auxiliary, encryption of the audio information, which is very worthy of protection, is impossible.

[0013] Also, the DVD-Audio specification does not stipulate a method or standard for recording moving picture information in a DVD-Audio region. Therefore, in the DVD-Audio specification, moving picture information cannot be recorded in the DVD-Audio region, and only reproducing management information for reproducing moving picture information recorded in the DVD-Video region, is recorded in the DVD-Audio region.

[0014] That is, only with the existing DVD-Audio specification and DVD-Video specification, a recording medium having a desired means for preventing illegal copying cannot be provided. Also, in a reproducing apparatus, which is made to reproduce DVD-Video information generated according to the existing DVD-Video specification, audio information recorded after being encrypted in a predetermined encryption method cannot be reproduced together with video information.

SUMMARY OF THE INVENTION

[0015] To solve the above problems, an object of the present invention is to provide a recording medium, on which encrypted audio data is recorded together with moving picture data.

[0016] It is another object to provide a recording medium, on which encrypted audio data, which is compatible with the existing specifications such as DVD-Video and DVD-Audio specifications, and audio data, which is not encrypted, are recorded together with moving picture data.

[0017] It is another object to provide a recording apparatus, which encrypts audio data and records the encrypted audio data together with moving picture data.

[0018] It is another object to provide a recording apparatus, which records encrypted audio data, which is compatible with the existing specifications, and audio data, which is not encrypted, together with moving picture data.

[0019] It is another object to provide a reproducing apparatus, which reproduces encrypted audio data from a recording medium on which the audio data is encrypted and recorded together with moving picture data.

[0020] It is another object to provide a recording method for encrypting audio data and recording the encrypted audio data together with moving picture data.

[0021] It is another object to provide a recording method for recording encrypted audio data, which is compatible with the existing specifications, and audio data, which is not encrypted, together with moving picture data.

[0022] It is another object to provide a reproducing method for reproducing encrypted audio data from a recording medium on which audio data is encrypted and the encrypted audio data is recorded together with moving picture data.

[0023] Additional objects and advantages of the invention will be set forth in part in the description which follows, and, in part, will be obvious from the description, or may be learned by practice of the invention.

[0024] To accomplish the above and other objects of the present invention, there is provided a recording medium comprising a video region, in which moving picture data and first audio data which is not encrypted is recorded, and an audio region, in which audio data and related additional information is recorded, the recording medium having a video region in which encrypted second audio data is recorded; and a predetermined region in which reproducing management information which reproduces video data and/or the encrypted second audio data of the video region is stored.

[0025] There is also provided a recording apparatus comprising a first encryptor which encrypts input moving picture data; a second encryptor which encrypts input audio data; and a recording processor which records the encrypted audio data and moving picture data in a predetermined format in the video region of a recording medium, and recording

reproducing management information which reproduces the encrypted audio data and/or video data, in a predetermined region of the recording medium.

[0026] There is also provided a reproducing apparatus for reproducing a recording medium comprising separate regions, a video region and an audio region, moving picture data and audio data, both data recorded in the video region, and reproducing management information, which is recorded in a predetermined region and used to reproduce the moving picture data and/or the audio data, the reproducing apparatus comprising a reproducing processor which analyzes whether audio data and/or video data recorded on the recording medium are encrypted and the encryption method, based on the reproducing management information read from the recording medium; a first decryptor which decrypts moving picture data read from the recording medium, according to information on whether the data is encrypted and the encryption method provided from the reproducing processor; and a second decryptor which decrypts audio data read from the recording medium, according to information on whether the data is encrypted and the encryption method provided from the reproducing processor.

[0027] There is also provided a recording method for recording data on a recording medium comprising a video region in which moving picture data is recorded, and an audio region in which audio data and related additional information is recorded, the recording method comprising encrypting input video data and/or audio data, and recording the encrypted video data and/or encrypted audio data in the video region; and recording reproducing management information for reproducing the encrypted video data and/or encrypted audio data, in a predetermined region.

[0028] There is also provided a reproducing method for reproducing a recording medium comprising separate regions, a video region and an audio region, moving picture data and encrypted audio data, both data recorded in the video region, and reproducing management information, which is recorded in a predetermined region and used to reproduce the moving picture data and/or the audio data, the reproducing method comprising analyzing whether audio data recorded on the recording medium is encrypted and the encryption method, based on the reproducing management information read from the recording medium; and decrypting audio data read from the recording medium, according to information on

whether the data is encrypted and the encryption method, and decoding the decrypted audio data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] The above objects and advantages of the present invention will become more apparent by describing in detail the several embodiments thereof with reference to the attached drawings in which:

[0030] FIG. 1 illustrates the data structure on a recording medium complying with existing DVD-Video and DVD-Audio specifications;

[0031] FIG. 2 illustrates the data structure on a recording medium, which is compatible with the existing DVD-Video and DVD-Audio specifications, and on which audio data encrypted according to the present invention is recorded;

[0032] FIG. 3 illustrates the structure of identification information complying with a DVD-Video specification which can distinguish encrypted audio data according to the present invention;

[0033] FIG. 4 illustrates the structure of identification information complying with a DVD-Audio specification which can distinguish encrypted audio data according to the present invention;

[0034] FIG. 5 is a block diagram according to an embodiment of a recording apparatus which records audio data encrypted according to the present invention;

[0035] FIG. 6 is a block diagram according to an embodiment of a reproducing apparatus which reproduces audio data encrypted according to the present invention; and

[0036] FIG. 7 is a block diagram according to another embodiment of a reproducing apparatus which reproduces audio data encrypted according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0037] Reference will now be made in detail to the present embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

[0038] FIG. 2 illustrates a data structure on a recording medium, which is compatible with the existing DVD-Video and DVD-Audio specifications, and on which audio data

encrypted according to the present invention is recorded. An example of a disc used in the present invention is a DVD-ROM having a 4.7-GByte capacity for recording video and audio information complying with the DVD-Video specification and audio information complying with the DVD-Audio specification.

[0039] On the region for DVD-Video of a disc according to the present invention, encrypted video data 31 and audio data which is not encrypted 32 (hereinafter, referred to as a first audio data) are multiplexed and recorded complying with the DVD-Video specification. Also, reproducing information (not shown) for reproducing these data 31 and 32 is recorded as management information in the DVD-Video region.

[0040] Meanwhile, the video data 31, the first audio data 32, and encrypted audio data 33 (hereinafter, referred to as a second audio data) are multiplexed and recorded. However, management information on the second audio data 33 is recorded so that the existing DVD-Video reproducing apparatus cannot reproduce the management data.

[0041] That is, the reproducing management information of the video data 31 and the first audio data 32, the management information for reproducing only the first audio data 32, the reproducing management information of the video data 31 and the second audio data 33, the management information for reproducing only the second audio data 33 are recorded in the DVD-Audio region. Here, the reproducing management information of the video data 31 and the first audio data 32, and the reproducing management information of the video data 31 and the second audio data 32 are recorded in an audio with video title (AVTT) 34, and the management information for reproducing only the first audio data 32 and the management information for reproducing only the second audio data 33 are recorded in an audio only title (AOTT) 35. Also, in the DVD-Audio region, audio data 38 and 39 which are encrypted complying with the DVD-Audio specification, together with the reproducing management information 36 and 37 for reproducing these audio data 38 and 39 are recorded in the AOTTs 36 and 37.

[0042] In a reproducing apparatus comprising only an audio decoder, only audio data in the music video information is reproduced. For this, separately from the information structure for reproducing video and audio data, the music video disc may have an information structure for reproducing only audio data. Using this information structure, an

apparatus for reproducing only for audio data can access and reproduce only audio data in the music video information.

[0043] In the information structure for reproducing only audio data, information on the audio data in the music video information is recorded. The information on the audio data comprises information on whether the audio data is encrypted to prevent illegal copying, and if the audio data is encrypted, in which encryption method the audio data is encrypted.

[0044] As an example of implementation, in case of a DVD music video disc, in which music video is recorded on a DVD, a video object (VOB) for music video is recorded in the DVD-Video region, and video data and audio data are recorded in a VOB. In the DVD-Audio region, an audio object (AOB), and AOTT and AVTT, each of which is an information structure for reproducing, are recorded. The reproducing information for reproducing only the audio data is recorded in the AOTT, while the reproducing information for reproducing both video data and audio data is recorded in the AVTT.

[0045] Referring to FIG. 2, in the DVD-Audio region, the AOTTs 36 and 37, each of which has a corresponding AOB, comprise reproducing information for reproducing the corresponding linked AOBs. The AOTT 34 and the AVTT 35 do not have their own AOBs and only contain reproducing information for reproducing VOBs in the DVD-Video region. In a case where data is reproduced using only the AVTT 35, both video data and audio data of the VOB data in the DVD-Video region are reproduced. In a case where data is reproduced using the AOTT 34, only audio data of the VOB data in the DVD-Video region is reproduced.

[0046] Although an encryption method to prevent illegal copying is applied only to video data of the VOB in the existing DVD-Video region, an encryption method is also applied to the audio data of the VOB, which is separately reproduced by being linked to the AVTT and/or the AOTT recorded in the DVD-Audio region, in the present invention. Information on whether an encryption method is applied and on which encryption method is applied is recorded in the AOTT linked to the corresponding audio data.

[0047] For example, in a case where an encryption method defined in the DVD-Video specification is applied to the video data recorded in the VOB of the DVD-Video region and an encryption method defined in the DVD-Audio specification is applied to the audio data recorded in the AOB of the DVD-Audio region, an encryption method defined in the

DVD-Video specification or an encryption method defined in the DVD-Audio specification is also applied to the audio data in the VOB, which is separately reproduced by being linked to the AOTT recorded in the DVD-Audio region.

[0048] However, since the existing DVD-Video reproducing apparatus can decrypt and reproduce only encrypted video data, the apparatus cannot reproduce audio data if an encryption method is applied to the audio data of the VOB. Therefore, audio data which is not encrypted is additionally recorded in the VOB. The audio data which is not encrypted has the same content as the audio data, which is encrypted and recorded in the VOB, but is recorded with a lower quality sound and/or less channels. For example, the audio data is encoded with a lower sampling frequency, less quantization bits, or a lower bit rates, and recorded. Therefore, the existing DVD-Video reproducing apparatus can simultaneously reproduce audio data and video data using audio data, which has a lower quality sound and is not encrypted, and video data. Meanwhile, a reproducing apparatus which reproduces a DVD music video disc according to the present invention can reproduce audio data having a high quality sound, and video data, because the apparatus can decrypt and decode the encrypted audio data.

[0049] Meanwhile, in a case where data on a disc having the data structure shown in FIG. 2 is reproduced in the existing DVD-Video reproducing apparatus, the encrypted audio data is seen as audio data which can be reproduced, on the reproducing list. However, the encrypted audio data cannot be reproduced indeed. Therefore, a definition is needed to make the encrypted audio data seen as audio data which cannot be reproduced, on the reproducing list, even where data on a disc having the data structure shown in FIG. 2 is reproduced in the existing DVD-Video reproducing apparatus. Also, in a reproducing apparatus which can reproduce encrypted audio data, definition of separate identification information in the DVD-Video region as shown in FIG. 3 is necessary, so that the encrypted audio data, which is seen as audio data which cannot be reproduced on the reproducing list, is seen as audio data which can be reproduced.

[0050] FIG. 3 illustrates the structure of program chain information (PGCI), which is management information of the DVD-Video region and comprises identification information which complies with the DVD-Video specification and can distinguish encrypted audio data according to the present invention.

[0051] The DVD-Video region comprises the management information structure of a program chain (PGC), and the management information which records information on the PGC is the PGCI. The PGCI comprises program chain general information (PGC_GI), and the PGC_GI comprises a PGC audio stream control table (PGC_AST_CTLT), which has an information structure having control information on each audio information of a PGC. In response to the audio information recorded after being encrypted, among the PGC_AST_CTLs recorded in the PGC_AST_CTLT, a predetermined condition, including encryption-related information which controls reproduction of audio information encrypted, is recorded in the corresponding PGC_AST_CTL.

[0052] In the PGC_AST_CTL, a flag which indicates whether audio information can be reproduced, which is the information on whether audio information indicated by the corresponding PGC_AST_CTL is used in the corresponding PGC, and a decoding audio stream number, which is the stream number of audio information indicated by the corresponding PGC_AST_CTL, are recorded. In the PGC_AST_CTL corresponding to the audio information which is recorded without encryption, an availability flag indicating whether audio data is reproducible is set so that the audio data is usable in the corresponding PGC, and the stream number of the corresponding audio information is recorded in the decoding audio stream number so that the audio data can be reproduced in the existing DVD-Video reproducing apparatus. Also, in the PGC_AST_CTL corresponding to the encrypted audio information, an availability flag indicating whether audio data can be reproduced is set as a conditional availability flag, which indicates that audio data can be conditionally reproduced, so that the audio data cannot be used in the existing DVD-Video reproducing apparatus, and can be used in a reproducing apparatus satisfying predetermined conditions. At the same time, the predetermined conditions including the encryption method related to the reproduction of the encrypted audio information is recorded in a reserved region of the PGC_AST_CTL, which is not used in the existing DVD-Video format. The stream number of encrypted audio information is recorded in the Decoding Audio stream number so that the existing DVD-Video reproducing apparatus cannot reproduce the encrypted audio information, and only a reproducing apparatus, which can recognize the predetermined conditions and satisfies the predetermined conditions, can reproduce the corresponding encrypted audio information.

[0053] FIG. 4 illustrates the structure of management information in which identification information, which complies with the DVD-Audio specification and can distinguish encrypted audio data according to the present invention, is stored.

[0054] In the DVD-Audio region, an information structure, referred to as AMG, which manages all the DVD-Audio region, an information structure, referred to as ATS information (ATSI), which is on each audio title set (ATS), and the copy of the ATSI, referred to as ATSI_BUP, are recorded. Also, AOB, which is data contained in each ATSI, is included in the DVD-Audio region.

[0055] As shown in FIG. 4, in the DVD-Audio region, an AOTT 41, which is formed only of an ATSI and an ATSI_BUP, and has no AOB, is included, and is the AOTT which reproduces only audio data in the music video data recorded in the DVD-Video region. The corresponding ATSI comprises an information structure, referred to as an ATSI management table (ATSI_MAT), which manages all the ATSI, and an ATS program chain information table (ATS_PGCIT). In the ATSI_MAT information structure, eight (8) information structures, each of which is referred to as an audio title video object attribute (AOTT_VOB_ATR). This information structure, AOTT_VOB_ATR, is a place which records attribute information of each of audio information recorded in the VOB used by the corresponding ATS. In this place, information related to the encryption method of the encrypted audio information contained in the corresponding VOB is recorded. In the audio title audio object attribute (AOTT_AOB_ATR) in the ATSI_MAT information structure, attribute information of the audio information recorded in the AOB of the DVD-Audio region is recorded.

[0056] Information complying with the existing DVD-Audio specification is recorded in the AOTT_VOB_ATR corresponding to the audio information which is recorded without encryption, and the predetermined conditions including the encryption method information related to the corresponding audio information are recorded in the AOTT_VOB_ATR corresponding to the encrypted audio information, so that the encrypted audio information can be used in a reproducing apparatus satisfying the corresponding predetermined conditions.

[0057] Referring now to FIG. 5, an embodiment of a recording apparatus which records audio data encrypted according to the present invention is shown in the form of a block

diagram. A video input processor 102 converts an input video signal into a form suitable for processing by a video encoder 104. The video encoder 104 encodes the converted video signal in a predetermined format, and provides the encoded video data to a video encryptor 106. The video encryptor 106 encrypts the encoded video data with an encryption method according to a predetermined specification, and provides the encrypted video data to a format generator 116.

[0058] An audio input processor 108 converts an input audio signal into a form suitable for processing by an audio encoder 110, and the audio encoder 110 encodes the converted audio signal in a predetermined format, and provides the encoded audio data to an audio encryptor 114. The audio encryptor 114 encrypts the encoded audio data with an encryption method according to a predetermined specification, and provides the encrypted audio data to a format generator 116.

[0059] The format generator 116 forms encrypted audio and video data into data having predetermined formats, and forms information structures which reproduce the corresponding video data and audio data. The formed data and information structures are recorded in a recording medium 120 through a recording controller 118 having a recording mechanism. Here, the video encryptor 106 and audio encryptor 114 can be referred to as a first encryptor and a second encryptor, respectively. Also, the format generator 116 and the recording controller 118 can be referred to as a recording processor.

[0060] The recording apparatus according to the present invention may further comprise an audio encoder 112 which additionally records audio data, which is not encrypted, so as to have a compatibility with a conventional video reproducing apparatus. The output of the audio encoder 112 is directly provided to the format generator 116 without applying the audio encryption method, and then formatted and recorded, so as to be reproduced by a conventional DVD-Video reproducing apparatus.

[0061] Where the recording apparatus shown in FIG. 5 is a DVD music video recording apparatus, the format generator 116 identifies a DVD-Video region and a DVD-Audio region, and in the VOB of the DVD-Video region, records video data, to which an encryption method defined in the DVD-Video specification is applied, and audio data, to which an encryption method defined in the DVD-Video specification, or an encryption method defined in the DVD-Audio specification is applied. Also, in the VOB of the DVD-

Video region, audio data, which passes the audio encoder 112 without applying the encryption method defined in the DVD-Video specification or the encryption method defined in the DVD-Audio specification, can be recorded together. The recording apparatus shown in FIG. 5 may have another encoder which encodes audio data, which is to be recorded in the DVD-Audio region shown in FIG. 2, in a predetermined format.

[0062] In the DVD-Audio region, reproducing information for reproducing the audio data of the VOB of the DVD-Video region is recorded in the AOTT having the structure shown in FIG. 4, and information related to encryption of the corresponding audio data is also recorded in the AOTT. Here, the information related to encryption of the corresponding encrypted audio data can be recorded in the PGCI having the structure shown in FIG. 3.

[0063] FIG. 6 is a block diagram according to an embodiment of a reproducing apparatus according to the present invention, and shows the structure of a music video reproducing apparatus which can reproduce both video and audio data.

[0064] A reproducing controller 204 having a reproducing mechanism reads data recorded in a recording medium 202 and provides the read data to a format interpreter 206. The format interpreter 206 interprets the read data, checks the locations of video data and audio data and illegal copying prevention states, then divides video data and audio data, and provides the video data to a video decryptor 208 and the audio data to an audio decryptor 214. The video decryptor 208 decrypts the video data provided by the format interpreter 206. A video decoder 210 decodes the decrypted video data. A video output processor 212 processes the decoded video data into a video signal appropriate to the output apparatus and outputs the processed video signal.

[0065] If an encryption method is applied to the audio data provided by the format interpreter 206, the audio interpreter 214 decrypts the audio data in the corresponding method, and if the audio data is not encrypted, provides the audio data to an audio decoder 216 without decryption. The audio decoder 216 decodes the audio data output from the audio decryptor 214, and an audio output processor 218 processes the decoded audio data into an audio signal appropriate to the output apparatus and outputs the processed audio signal. Here, the video decryptor 208 and the audio decryptor 214 can be referred to as a first decryptor and a second decryptor, respectively, and the reproducing controller 204 and the format interpreter 206 can be referred to as a reproducing processor. The reproducing

apparatus shown in FIG. 6 may further comprise a separate audio decoder which decodes audio data recorded in the DVD-Audio region.

[0066] In a case of a DVD music video reproducing apparatus which can reproduce both video and audio data, the format interpreter 206 interprets the information structures (FIGS. 3 and/or 4) for reproducing video data and audio data respectively recorded in the DVD-Audio region and/or the DVD-Video region, and reproduces video data and audio data recorded in the VOB of the DVD-Video region according to the interpreted reproducing information. At this time, if information related to the encryption method of the corresponding audio data is recorded in the reproducing information, the audio decryptor 214 is operated according to the information related to the encryption method.

[0067] FIG. 7 is a block diagram according to another embodiment of a reproducing apparatus according to the present invention, and shows the structure of a music video reproducing apparatus which reproduces only audio data.

[0068] A reproducing controller 304 reads data recorded on a recording medium 302 and provides the read data to a format interpreter 306. The format interpreter 306 interprets the read data, checks the locations of the video data and audio data, and illegal copying prevention states, using the information structure for reproducing only the interpreted audio data, then separates the audio data from the read data, and provides the audio data to an audio decryptor 308.

[0069] If an encryption method is applied to the audio data provided by the format interpreter 306, the audio decryptor 308 decrypts the audio data using a corresponding method, and provides the decrypted audio data to an audio decoder 310. If the audio data is not encrypted, the audio decryptor 308 provides the audio data to the audio decoder 310 without decryption. The audio decoder 310 decodes audio data output from the audio decryptor 308, and an audio output processor 312 processes the decoded audio data into an audio signal appropriate to the output apparatus and outputs the processed audio signal.

[0070] In a case of a DVD music video reproducing apparatus which reproduces only audio data, the format interpreter 306 interprets the AOTT of FIG. 4, which is an information structure for reproducing only audio data in the DVD-Audio region, and reproduces audio data in the VOB in the DVD-Video region linked to the corresponding AOTT. At this time, if information related to the encryption method of the corresponding

audio data is recorded in the corresponding AOTT, the audio decryptor 308 is operated according to the information related to the encryption method.

[0071] As described above, in the present invention, for compatibility with the existing specifications, encrypted audio data and audio data which is not encrypted are recorded together with video data. By doing so, video data and two-types of audio data are reproducible in each combination (video + encrypted audio, and video + audio data which is not encrypted), while only audio data can be separately reproduced.

[0072] In addition, in the present invention, both encrypted audio data and audio data which is not encrypted are prepared together so that audio data is reproducible in a reproducing apparatus complying with the existing specifications, while higher quality audio can be reproduced in the reproducing apparatus according to the present invention, and protection of copyright is enabled.

[0073] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.